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(54) **Polymer backed material with non-slip surface and method of making same.**

(57) Non-slip laminatable materials are provided by coating a polymer sheet backing with mineral particles adhered to the backing by a radiation curable adhesive.

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and 4,588,419 are specifically included herein by this reference in respect to their respective pertinent description and discussions of the relevant factors applicable to the electron beam formation of coated abrasives and variants thereof.

These and other features, aspects and details of the present invention can be more readily comprehended from the independent claims 1, 5, 7 and 14, the dependent claims, the following text of the specification, the example and by reading the cited references.

The invention provides polymer, e.g. polyvinyl chloride backed products with non-slip surfaces also referred to as coated abrasive products and methods of making such products. In this context it is to be understood that the term coated abrasive material or product is not used in the sense of a material or product suitable for abrading or grinding a surface but rather in the sense of a material which has a rough non-slip surface.

The products of the present invention comprise a polymer backing material and, adhered to the surface of the backing by a radiation-curable adhesive, mineral particles so as to provide a non-slip surface.

The products of the present invention will, in many cases (but not, necessarily, always), be laminated or bonded to other substrates of natural and synthetic materials, e.g., wood, concrete, metal, polyurethanes, polyethylenes, polyesters, isoprenes, synthetic and natural rubbers, etc., in particular, other substrates preferably of polyvinyl chloride material. Some of these other substrates may have relatively complex surface configurations, e.g., extruded, polyvinyl chloride floor matting materials. Thus, the products of the present invention must, in many cases, be severely deformed or "shaped" to permit substantially the full surface areas thereof to come into substantial surface-to-surface, or face-to-face contact with those complex surface configurations of such other substrates, to enable such lamination or bonding, substantially at all points of contact, therebetween.

It is also highly preferred that the materials selected should be thermoformable as a unit without decomposition of any of the components or delamination by failure of the bond between the backer material and the resin bonding the mineral particles to the backer material. To ensure the capability of deformation or "shaping", it is also important for the products of the present invention to be able to flex to a significant degree. For other applications, the products of the present invention may be used directly; i.e., without being bonded to a substrate; in such applications the backer, per se, also usually functions as the substrate.

In practice, therefore, to permit such bonding, flexing and/or thermoforming, it is preferred that

several of the physical properties of the resin system(s), used to bond the mineral or abrasive particles of the present invention to the backer be as closely matched as possible to the backer which is used. Examples of such physical properties, which are deemed important to be substantially matched, include flexibility, stretchability, yield, tensile, elongation, deformation, rate of softening, melt point, etc. Thus, it is considered a key feature of the present invention that the resin systems, described hereinafter, when applied as hereinafter described, and when radiation cured, preferably electron beam cured, have such physical properties, particularly in regard to flexibility, that when bonded to the backer which is used, e.g., the preferred polyvinyl chloride backer sheet or film materials preferably in the range of 6 mils or less in thickness, the tensile strength of the product of the present invention is equivalent to or greater than that of the backer which is used, and the elongation potential of such product of the present invention is not less than 25% of that original backer material but with that product of the present invention still capable of being stretched (elongated) in any given direction, without tearing, to a dimension which is at least 110% and preferably 125% of the corresponding unstretched (unelongated) dimension; this ensures sufficient flexibility for the deformation and "shaping" as discussed above. The present invention is not, however, limited to application to backer materials which are 6 mils or less in thickness.

The resin system(s) of the present invention, in addition, has (have) relatively unique physical properties not apparent in many backer materials, e.g., the preferred polyvinyl chloride, e.g., such physical properties as the capability of readily bonding to the mineral particles e.g. abrasive grain particles, of the present invention, the capability of holding those particles securely in place while physical forces are applied thereto in use and the capability of complementing the flexibility properties of those backer materials. Finally, the resin system(s) of the present invention is (are) designed to be substantially at least as resistant to chemical attack (corrosion) as the selected backer material, e.g., polyvinyl chloride backer, and to exhibit substantially at least an equivalent degree of durability in comparison to the selected backer material, e.g., polyvinyl chloride backer material. It is, of course, highly desirable that it is thermoformable under conditions in which the backer material can be thermoformed.

Mineral particles, or abrasive mineral grit material, e.g., aluminum oxide, silicon carbide, fumed silica and silica gel, preferably in the form of standard grain size particles, preferably within the range of about 50 grit to about 220 grit, in size, are

present invention is linearly extruded, preferably through a conventional extrusion die, along with a selected substrate material, preferably polyvinyl chloride, by conventional extrusion methods and using conventional extrusion equipment, to produce, for example, a floor mat with the product of the present invention bonded to the surface thereof. The product of the present invention is, preferably, laminated and bonded to a selected substrate, e.g., a polyvinyl chloride solid article, which may or may not be heat pre-softened, by the application of heat and pressure, by methods which are well known to those with skill in the art; alternatively the surface of the polyvinyl chloride or other substrate material may be rendered molten by the application of heat and/or pressure. Further, adhesive materials, as are conventionally used to bond together polymer materials, e.g., to bond polyvinyl chloride together, or to bond polyvinyl chloride or other polymers to dissimilar polymers or to other materials, may likewise be utilized where such backers and/or substrates are used.

Although the most preferred backer material of the present invention is polyvinyl chloride, the backer material may be selected from the group consisting of polyvinyl chloride polyethylene, polyurethane, polyethylene terephthalate (polyester), polypropylene, polyamide, polysulfide, polystyrene, polyvinyl acetate, polybutadiene, acrylonitrile-butadiene, acrylonitrile-butadiene-styrene copolymer, styrene-butadiene, acrylonitrile-styrene copolymer and vinylidene chloride, with the more preferred backer materials being polyurethane, polyethylene, polyester, polyamide, polypropylene and polysulfide.

These and other features of the present invention may be better understood from a reading of the following specification text and the appended claims.

#### DETAILED DESCRIPTION OF THE INVENTION

The polymer backed non-slip or abrasive products, of the present invention, may be prepared by coating preferably a polyvinyl chloride backer material with inorganic mineral particles such as inorganic abrasive grit. The preferred polyvinyl chloride material may be any commercially available polyvinyl chloride, but preferably is sheeting or film, and should be preferably of a thickness which will enable sufficient structural integrity for handling, but which is also sufficiently flexible and pliable to be continuously fed through radiation curing equipment, e.g., electron beam curing equipment, adapted to produce non-slip sheet products or coated abrasive products. The preferred polyvinyl chloride backing material, preferably sheet or film, is preferably about 10 mils or less in

thickness, more preferably about 6 mils or less in thickness, although the present invention is not limited to applications wherein the polyvinyl chloride backing, or other backing material, is 10 mils or less in thickness.

A variety of mineral particles or inorganic abrasive grit particles may be employed which will provide adequate frictional contact in use to prevent, or aid in the prevention of, slippage or skidding. Examples of suitable mineral particles are aluminum oxide, silicon carbide, fumed silica and silica gel; other mineral materials which are adaptable to radiation curing, in particular electron beam curing, may also be utilized.

A maker and size coating comprising at least one resin system which is radiation curable, preferably electron beam curable, and provides a durable size coating for the intended use of the product is utilized. A maker coat is the resin coat onto which the particles are deposited. A size coat is the coat which is placed over the particles to aid in holding them onto the substrate during flexing and wear applications, usually in combination with some form of pressure or other applied physical force. A second size coat, sometimes referred to as an "over" or "super size" coat, may also be applied, if desired, although in many cases this is not necessary. The amount of the maker and size coats applied are whatever is sufficient to adequately hold and secure the particles to the polyvinyl chloride substrate, of the present invention, in subsequent use, i.e., as a stand-alone product or by bonding and/or lamination to some other substrate; and in final application, e.g., a floor or a floor mat surface, a hand tool grip or other non-slip applications, as are well known to those skilled in the art. The methods of applying the coatings of the present invention may be selected from those which are conventionally used with the electron beam curing methods of forming coated abrasive products. Among typical methods, for examples, are knife coating, roll pressure coating, transfer roll coating and doctor blade coating. The preferred method of coating used for the present invention is pressure roll coating.

The resin system is chosen to match, in its preferred electron beam cured form, certain physical properties of the preferred polyvinyl chloride backer. The properties of the resin systems which are deemed to be significant are those described above, i.e., such as flexibility, stretchability, yield, tensile, elongation, deformability, rate of softening, melt point, corrosion resistance, durability, capability of securely bonding to both the mineral particles and the preferred polyvinyl chloride backer of the present invention and, of course, the capability of being readily radiation cured, preferably electron beam cured, as applied to a preferred polyvinyl

7. A non-slip article especially according to one of the preceding claims comprising a polymeric backing of material selected from the group consisting of polyvinyl chloride, polyethylene, polyurethane, polyethylene terephthalate (polyester), polypropylene, polyamide, polysulfide, polystyrene, polyvinyl acetate, polybutadiene, styrene-butadiene, acrylonitrile-butadiene, acrylonitrile-styrene copolymer, acrylonitrile-butadiene-styrene copolymer and vinylidene chloride, said polymeric backing having from 10 to 25 lb./ream of a mineral particulate material bonded thereto by from about 4 to 15 lbs./ream of radiation cured polyurethane binder material, and wherein the linear tensile strength of the non-slip article is at least as great as the linear tensile strength of said polymeric backing, and wherein the elongation capability (before tearing occurs), of said non-slip article, is at least 25% of that of the original polymeric backing material, and said elongation capability (before tearing occurs) of said non-slip article is at least 110% and preferably 125%, in any given direction, of the unelongated dimension of the finished product in the same direction, the backer material and the resin bonding material being selected such that the non-slip is thermoformable without delamination or decomposition of the components.
8. The article of claim 7 wherein said elongation capability (before tearing occurs) is at least 30% of that of said polymeric backing, and said elongation capability (before tearing occurs) is at least 140% in any given direction, of the unelongated dimension in that same direction.
9. The article of claim 7 wherein said elongation capability (before tearing occurs) is at least 40% of that of said polymeric backing, and said elongation capability (before tearing occurs) is at least 150% in any given direction, of the unelongated dimension in that same direction.
10. The article of one of claims 7 to 9 which comprises from 15 to 25 lb./ream of said mineral particulate material.
11. The article of one of claims 7 to 10 which comprises from 8 to 12 lb./ream of radiation cured polyurethane binder material.
12. The article of one of claims 7 to 11 wherein said radiation cured polyurethane binder material is electron beam cured binder material.
13. The article of one of claims 7 to 12 wherein said polymeric backing of material is selected from the group consisting of polyvinyl chloride, polyurethane, polyethylene, polyester, polyamide, polypropylene and polysulfide.
14. A method of producing a polymer backed coated non-slip sheet article comprising:
  - a. selecting a backer material from the group consisting of polyvinyl chloride, polyethylene, polyurethane, polyethylene terephthalate (polyester), polypropylene, polyamide, polysulfide, polystyrene, polyvinyl acetate, polybutadiene, styrene-butadiene, acrylonitrile-butadiene, acrylonitrile-styrene copolymer, acrylonitrile-butadiene-styrene copolymer and vinylidene chloride;
  - b. applying at least one coating of at least one radiation curable urethane oligomer resin system onto a surface of said backer material;
  - c. applying mineral articles to said backer material and said urethane oligomer resin system coated onto said backer material; and
  - d. radiation curing said urethane oligomer resin system to bond said mineral particles to said backer material; the backer material and the resin bonding materials being selected as in one of claims 1 to 4.
15. The method of claim 14 wherein said mineral particles are blended into said resin system before said resin system is applied to said backer material, with said mineral particles and said resin system first being combined to form a slurry, with said slurry then being applied to said backer material, thus combining steps b. and c. of claim 14.
16. The invention of claim 14 or 15 wherein said polymer backer material is selected from the group consisting of polyvinyl chloride, polyurethane, polyethylene, polyester, polyamide, polypropylene and polysulfide.
17. The invention of one of claims 14 to 16 wherein said resin is electron beam cured from said at least one urethane oligomer resin system which is electron beam curable.
18. The invention of one of claims 14 to 17 wherein said mineral particles are selected from the group consisting of aluminum oxide, silicon carbide, fumed silica and silica gel.



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